Temper, Temper

Why is tempering chocolate so important?

Stock items	Consumables
Bin bags	Milk chocolate
Plastic tubs with lids	Access to a microwave
Plastic knife	Access to a fridge
Spoon	
Microwavable bowl	

Presenting ideas

You'll need to keep half the chocolate and melt and quickly cool the other half. To do this, break half of your chocolate up into pieces in a microwavable bowl and whizz it in the microwave for 30 second bursts. It may take a couple of minutes but take care not to burn the chocolate. Stir until it's all melted. Pour your molten chocolate into the plastic tub (I find cheap lunch boxes work well) and pop it into the fridge. Once it has almost set, score it with a plastic knife to make similar-sized pieces as the chocolate still in the wrapper. This will make it easier to break apart when it's completely set. This is your untempered chocolate. Label this, as well as the tempered chocolate straight from the packet in different plastic tubs.

Invite your *edible explorer* to pick up one square of the tempered chocolate and one square of the untempered chocolate.

- Do they look different? If so, how?
- Try snapping both samples – do they sound and feel the same?
- Taste them both. How does the taste differ?
- Do they both have the same texture?
- Have you heard about tempering chocolate? What do you know about it?

What's the chemistry?

The edible properties of the *Theobroma cacao* tree were discovered over 2,000 years ago. Chocolate arrived in Spain in the 16th century, where it was initially met with some unfavourable comments until it was discovered a sweetened version was more palatable. It was then enjoyed throughout Europe, initially as a luxury before becoming one of our favourite sweet treats.

The fruit of *Theobroma cacao* are known as cocoa pods which contains a few dozen seeds which when dried and fermented in the sun are known as cocoa beans. Chemically, cocoa beans contain roughly 50 % cocoa butter, a fatty substance that allows chocolate to remain a semi-solid at room temperature but melts readily in the mouth.

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A typical chocolate bar consists of solids such as cocoa and milk solids and sugar, which are dispersed in cocoa butter and milk fats. An emulsifier, usually soya lecithin, helps the hydrophilic (water-loving) sugar and hydrophobic (water-hating) fats to evenly disperse.

The taste of chocolate depends on its microstructure. The key ingredient is the fatty cocoa butter, which can exhibit six different crystal configurations. These configurations are simply the way the atoms are arranged. This tiny difference gives rise to vastly different properties.

The ability of a substance to exhibit different crystal structures is called polymorphism and only one of the six crystal forms of cocoa butter makes a glossy, superior chocolate with a crisp snap.

Form	Melting point	Texture and appearance
I	17.3 °C	Soft, crumbly and grainy with blooming in the surface
II	23.3 °C	Similar to form I
III	25.5 °C	Firm but no crisp snap
IV	27.3 °C	Similar to form III
V	33.8 °C	Smooth, glossy, good snap, melts in the mouth
VI	36.3 °C	Hard, does not melt quickly in the mouth

Form V crystals are the most desirable, as they give a stable, glossy finish and a pleasant texture. The chocolate straight from the packet will primarily consist of form V. In the sample you have heated and cooled, you will have a mixture of forms I-V and this is why the untempered chocolate will be softer, lacking that crisp snap and hard bite, as it contains crystal forms which have already melted at room temperature.

Form V is not the most stable and requires tempering to generate it. Tempering involves melting chocolate to between 40 – 45 °C, pouring about three quarters of it onto a cold marble work surface and continually moving it until it reaches a specific consistency. It's then poured back into the rest of the chocolate and stirred until it forms an even mixture. An easier way of tempering involves adding small pieces of tempered chocolate to melted chocolate. These pieces act as little templates, allowing the molten chocolate to crystallise in the same form.

Form VI only occurs when form V crystals clump together over time, meaning older chocolate doesn't taste as pleasant as it once did. Fat bloom could also occur; you may have seen this as a white coating on the surface and occurs when fats migrate from the inside to the outside of the chocolate bar. It's still perfectly safe to eat but doesn't look that appetising. Although chocolate doesn't have chance to get to that stage in my house!

Jo's Top Tips

This experiment works best on cooler days. When it's warm, more of the crystal structures have melted and it's far trickier to distinguish between the tempered and untempered forms.

I untemper the chocolate a few days before I'm going to get people to taste. Over time, the crystal structures transform. When you initially cool the chocolate, you'll predominantly create forms I and II, which partly convert to forms III and IV at room temperature.

Always make sure you know the allergy advice on the chocolate you're using. I make them visible by writing any allergens on chalk boards but you could print them out.

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